The Future is Here: What Can Robotics Do for Individuals with Spinal Cord Injury

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**DISCLOSURE**

Dr. Bonato serves as a member of the scientific advisory board of Hocoma AG. Dr. Bonato does not receive compensation for this position.

**TECHNOLOGY TO SERVE HUMANITY**

Engineers are working for you ...

Are engineers doing a good job?
“Humans are not disabled. A person can never be broken. Our built environment, our technologies, are broken and disabled. We the people need not to accept our limitations, but can transcend disability through technological innovation.”

Hugh Herr
THE FUTURE IS HERE …

Homayoon Kazerooni
UC Berkeley

Gregoire Courtine
EPFL

First Day of Tomorrow
UNDERSTANDING REHABILITATION ROBOTICS

Retraining

Augmenting

Restoring

RETRAINING UPPER LIMB MOTOR FUNCTION

[Video Clip]

Barrett Technology
**Prosthetic Training**

**Upper Limb Motor Function**

*Pros*
- Efficacy data in many populations.
- Advanced control techniques.

*Cons*
- Limited efficacy data in SCI.
- Current use marked by low dosage.

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**Lower Limb Motor Function**

Northeastern University and Spaulding Rehabilitation Hospital

Robert Riener ETH

Neville Hogan Igo Krebs MIT

Motion Analysis Laboratory
**RETRAINING LOWER LIMB MOTOR FUNCTION**

**Pros**
- Good efficacy data in SCI.
- Progress in control techniques.

**Cons**
- Training does not challenge balance.
- Current use marked by low dosage.

**THE ROBOTIC GYM**

Toward the implementation of high-dosage interventions …

Courtesy of Hocoma
AUGMENTING UPPER LIMB MOTOR FUNCTION

Myomo

Harry Asada
MIT

Gregory Fischer
WPI

Robert Howe
Harvard Univ

AUGMENTING LOWER LIMB MOTOR FUNCTION

[Video Clip]
Monitoring the use of wearable robotic systems in the home and community settings is of paramount importance. It is essential to assure users’ safety and to gather data to continue to improve the reliability of such systems.
SERVICE ROBOTS

Robert Howe
Harvard Univ

William Townsend
Barrett Technology

Kinova Robotics

George
Whitesides
Harvard Univ

Motion Analysis Laboratory
Gregoire Courtine at EPFL is developing techniques in animal models that he hopes to be able to use in patients in the future.

Robert Kirsch, Case Western Univ

Restoration of reaching and grasping movements through brain-controlled muscle stimulation in a person with tetraplegia: a proof-of-concept demonstration

The Lancet
March 28, 2017
CONCLUSIONS

- Although the technology is “broken” ... the future is here.

- Robotic technology provides unique opportunities to retrain, augment, and restore motor function.

- The implementation of high-dosage retraining interventions could be tremendously facilitated by robotics.

- The use of wearable robots for augmentation is becoming reality and safe thanks to sensor-based remote monitoring.

- Many technologies are enabling the restoration of function via “repair” as well as via bypassing spinal lesion areas.
Knowledge in Motion
Q & A

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Erick Larson, Consumer
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